

CLAIMS

1. A programmable mask comprising:
a plurality of optical modulators arranged in an array, said plurality of optical modulators each including at least one nano-particle;
and
a control arrangement operatively coupled to said optical modulators, said control arrangement applying a stimulus to said nano-particles to thereby cause said nano-particles to change optical properties.
2. The programmable mask of claim 1 further including a pattern control generator coupled to said control arrangement, said pattern control generator applying control signals defining a programmable light exposure pattern.
3. The programmable mask of claim 1 wherein said control arrangement applies an electrical magnetic stimulus to said nano-particles.
4. The programmable mask of claim 1 wherein said programmable mask includes a silicon substrate, and said control arrangement includes electrical paths disposed on said silicon substrate.
5. The programmable mask of claim 1 wherein said programmable mask includes a silicon-on-sapphire substrate and said control arrangement includes active devices disposed on said substrate.
6. The programmable mask of claim 1 wherein said programmable mask includes a silicon-on-sapphire substrate with said control arrangement and at least part of active devices disposed on another substrate.
7. The programmable mask of claim 1 wherein said programmable mask includes a substrate having back-etched portions to provide a

light path therethrough, said nano-particles being optically coupled to said back-etched portions.

8. The programmable mask of claim 1 wherein said nano-particles are placed in a hole that is surrounded by two metal thin films separated by an insulator.
9. The programmable mask of claim 1 wherein said nano-particles comprise semiconductors.
10. The programmable mask of claim 1 wherein said nano-particles comprise materials selected from the group consisting of C, Si, Ge, CuCl, CuBr, CuI, AgCl, AgBr, AgI, Ag₂S, CaO, MgO, ZnO, Mg_xZn_{1-x}O, ZnS, HgS, ZnSe, CdS, CdSe, CdTe, HgTe, PbS, BN, AlN, Al_xGa_{1-x}N, GaN, GaP, GaAs, GaSb, InP, InAs, In_xGa_{1-x}As, SiC, Si_{1-x}Ge_x, Si₃N₄, ZrN, CaF₂, YF₃, Al₂O₃, SiO₂, TiO₂, Cu₂O, Zr₂O₃, ZrO₂, SnO₂, YSi₂, GaInP₂, Cd₃P₂, Fe₂S, Cu₂S, CuIn₂S₂, MoS₂, In₂S₃, Bi₂S₃, CuIn₂Se₂, In₂Se₃, HgI₂, PbI₂.
11. The programmable mask of claim 1 wherein said nano-particles are in spherical, cubic, rod like, tetragonal, single or multi-walled nano-tube or other nano-scale geometric shapes.
12. The programmable mask of claim 1 wherein said nano-particles are immersed in a polymer matrix or other chemicals.
13. The programmable mask of claim 1 wherein said nano-particles are capped with other functional materials.
14. A method of exposing a surface comprising:
 - stimulating nano-particles based on pattern data to change the optical characteristics thereof;
 - directing photons toward said stimulated nano-particles to generate a pattern of photons corresponding to said pattern data; and
 - exposing a surface with said photon pattern.

15. The method of claim 16 wherein said surface comprises a photoresist.
16. The method of claim 16 wherein said surface comprises a contrast enhancement layer containing nano-particles and/or organic materials.
17. The method of claim 16 wherein said photon pattern comprises a two-dimensional pattern.
18. The method of claim 16 wherein said nano-particles are arranged in an array forming a plurality of discrete optical modulators.
19. The method of claim 16 wherein said stimulating step comprises applying a current, voltage or field to said nano-particles.
20. A process for fabricating a programmable mask comprising:
 - providing a substrate having control circuitry thereon; and
 - applying nano-particles to at least a portion of said substrate.
21. The process of claim 20 wherein said applying step comprises mixing nano-particles with a liquid and interacting said liquid with said substrate.
22. The process of claim 20 wherein said interacting comprises spraying, spinning, dipping, rinsing and other methods to apply said liquid onto said substrate.
23. The process of claim 20 wherein said liquid comprises a polymer and/or a solvent.
24. The process of claim 20 wherein said liquid comprises a solid, liquid or polymer electrolyte.
25. The process of claim 20 wherein said applying step comprises applying said nano-particles to said substrate to define a pattern.
26. The process of claim 20 wherein said substrate comprises silicon.
27. The process of claim 20 wherein said substrate comprises silicon-on-sapphire.

28. The process of claim 20 further including back etching portions of said substrate to provide light-transparency.
29. A method of fabricating a programmable mask comprising;
a first layer of plurality of optical modulators arranged in an array,
said plurality of optical modulators each including at least one control circuitry and at least one transparent or semi-transparent area comprising electrolyte or other organic and/or inorganic substances;
a second layer comprising nano-particles; and
binding the two layers together to form the programmable mask.
30. The programmable mask of claim 29 wherein the first layer comprises an substrate thereon: control circuitry is deposited
31. The programmable mask of claim 29 wherein the first layer comprises an electrode
32. The programmable mask of claim 29 wherein the first layer comprises a light blocking layer
33. The programmable mask of claim 29 wherein the second layer comprises an electrode
34. The programmable mask of claim 29 wherein the second layer comprises nano-particles
35. The programmable mask of claim 29 wherein said programmable mask includes a silicon substrate, and said control arrangement includes electrical paths disposed on said silicon substrate.
36. The programmable mask of claim 29 wherein said programmable mask includes a silicon-on-sapphire substrate and said control arrangement includes active devices disposed on said substrate.
37. The programmable mask of claim 29 wherein said programmable mask includes a silicon-on-sapphire substrate with said control

arrangement and at least part of active devices disposed on another substrate.

38. The programmable mask of claim 29 wherein said nano-particles comprise a solid, liquid or polymer electrolyte.
39. The programmable mask of claim 29 wherein said programmable mask includes a substrate having back-etched portions to provide a light path therethrough, said nano-particles being optically coupled to said back-etched portions.